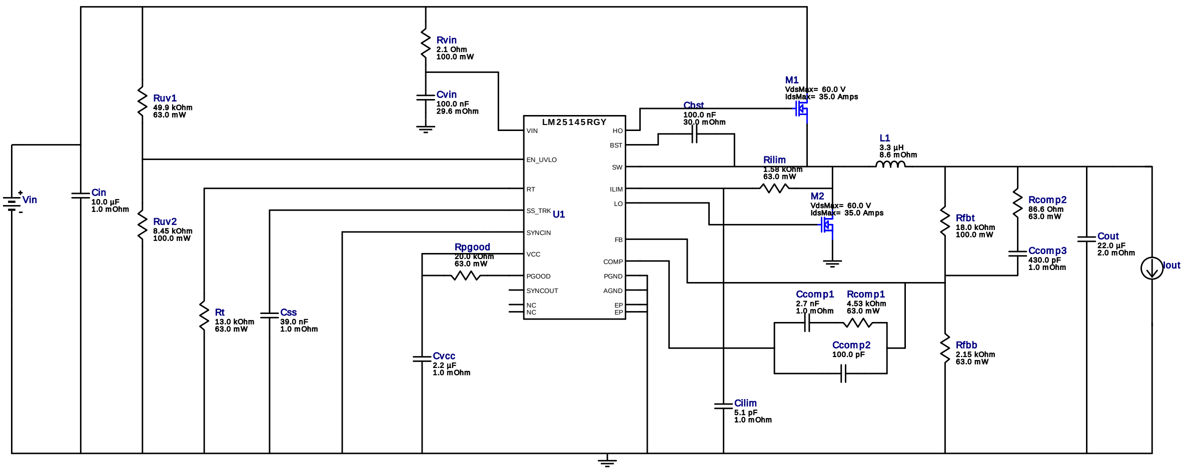
VinMin = 10.0V
VinMax = 26.0V
Vout = 7.5V
Iout = 8.0A

Device = LM25145RGYR
Topology = Buck
Created = 2022-02-14 02:44:53.583
BOM Cost = $3.69
BOM Count = 24
Total Pd = 3.76W

WEBENCH ® Design Report

Design : 12 LM25145RGYR
LM25145RGYR 9V-26V to 7.50V @ 8A

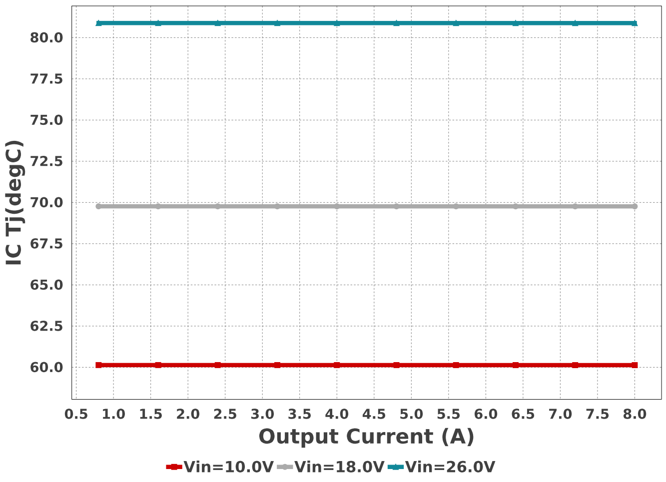


Electrical BOM

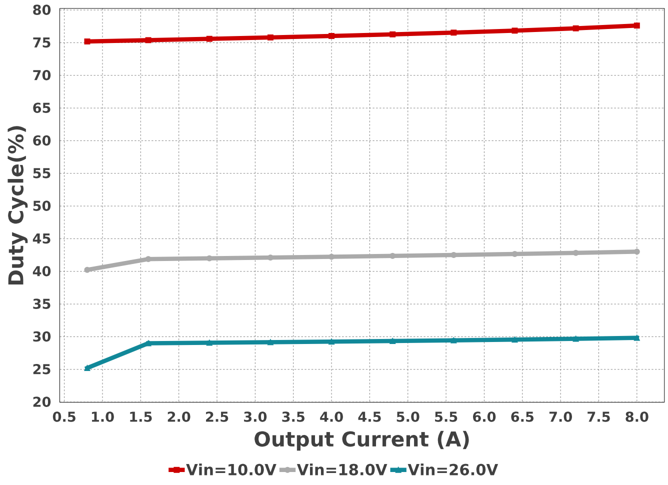
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM188R61E104KA01D Series= X5R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Ccomp1	MuRata	GRM155R71H272KA01D Series= X7R	Cap= 2.7 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	Kemet	C0402C101K4GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp3	MuRata	GRM1555C1E431JA01D Series= C0G/NP0	Cap= 430.0 pF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm^2
Cilim	MuRata	GQM2195C2A5R1CB01D Series= C0G/NP0	Cap= 5.1 pF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.15	0805 7 mm^2
Cin	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	1	$0.28	1210 15 mm^2
Cout	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	1	$0.55	1210 15 mm^2
Css	MuRata	GRM155R61A393KA01D Series= X5R	Cap= 39.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cvcc	TDK	C1005X5R1V225K050BC Series= X5R	Cap= 2.2 uF ESR= 1.0 mOhm VDC= 35.0 V IRMS= 0.0 A	1	$0.07	0402_065 3 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cvin	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	$0.01	0603 5 mm^2
L1	Coilcraft	XAL7070-332MEB	L= 3.3 µH 8.6 mOhm	1	$1.19	XAL7070 87 mm^2
M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.26	DNH0008A 18 mm^2
M2	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.26	DNH0008A 18 mm^2
Rcomp1	Vishay-Dale	CRCW04024K53FKED Series= CRCW..e3	Res= 4.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rcomp2	Vishay-Dale	CRCW040286R6FKED Series= CRCW..e3	Res= 86.6 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW04022K15FKED Series= CRCW..e3	Res= 2.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	RC0603FR-0718KL Series= ?	Res= 18.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rilim	Vishay-Dale	CRCW04021K58FKED Series= CRCW..e3	Res= 1.58 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpgood	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rt	Vishay-Dale	CRCW040213K0FKED Series= CRCW..e3	Res= 13.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv1	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv2	Yageo	RC0603FR-078K45L Series= ?	Res= 8.45 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rvin	Vishay-Dale	CRCW06032R10FKEA Series= CRCW..e3	Res= 2.1 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
U1	Texas Instruments	LM25145RGYR	Switcher	1	$0.76	RGY0020B 25 mm^2

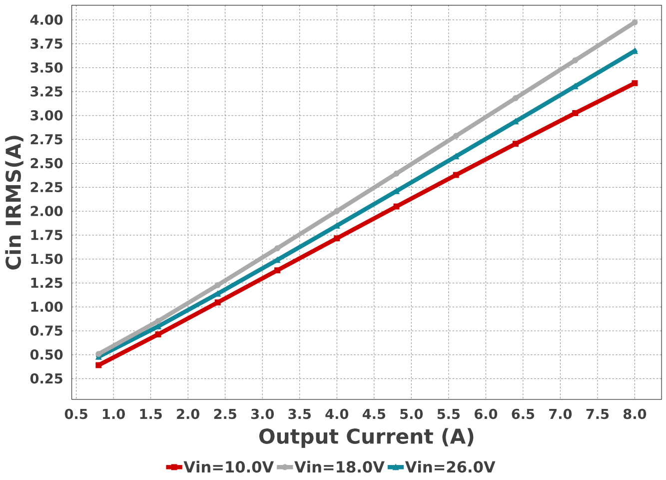
IC Tj



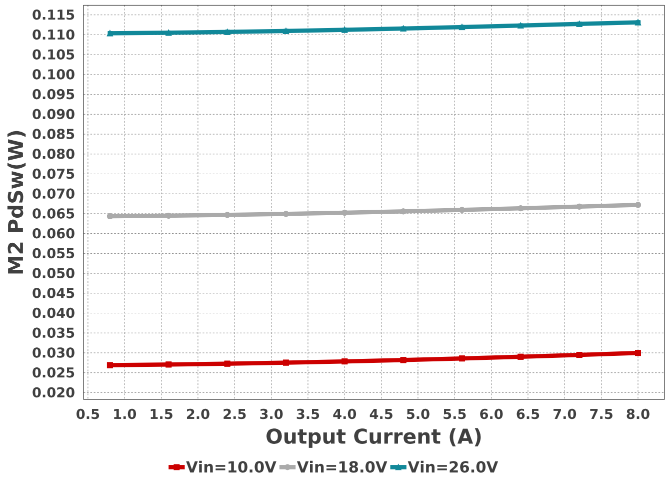
Duty Cycle



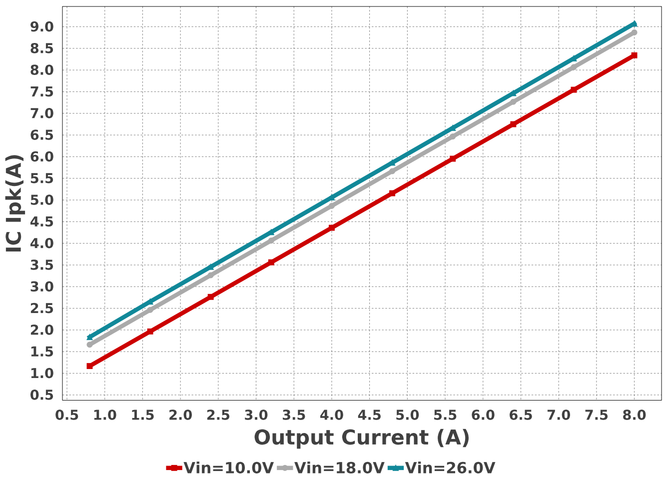
Cin IRMS



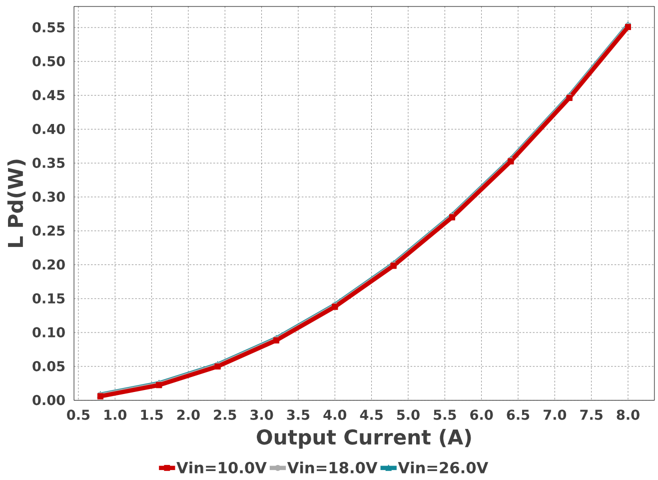
M2 PdSw



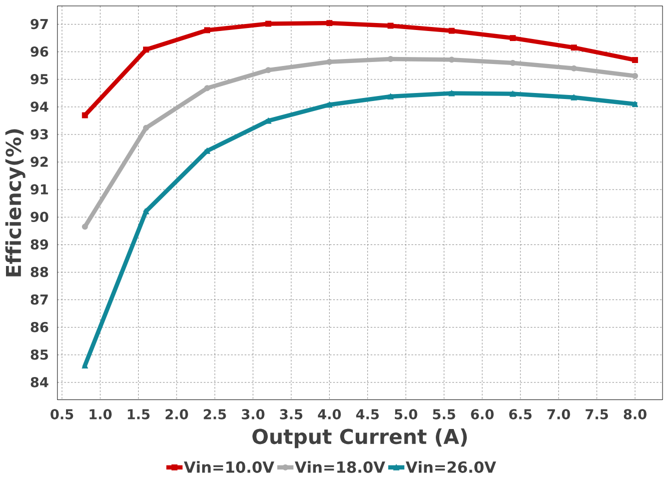
IC Ipk



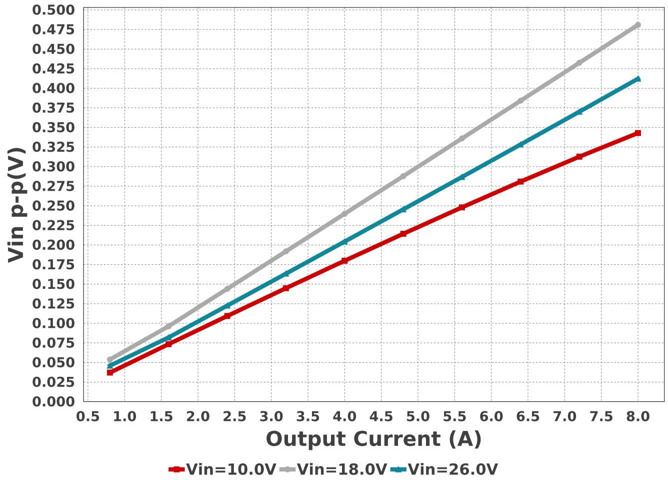
L Pd



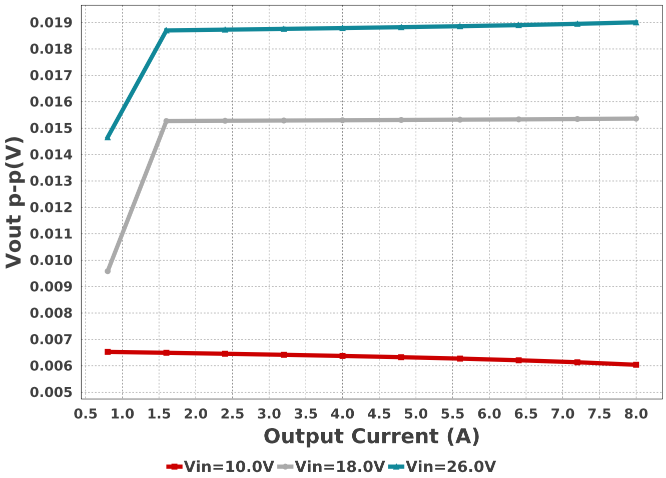
Efficiency



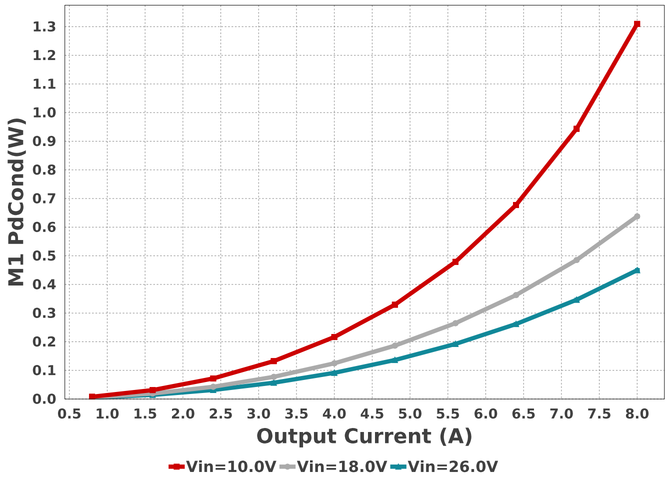
Vin p-p



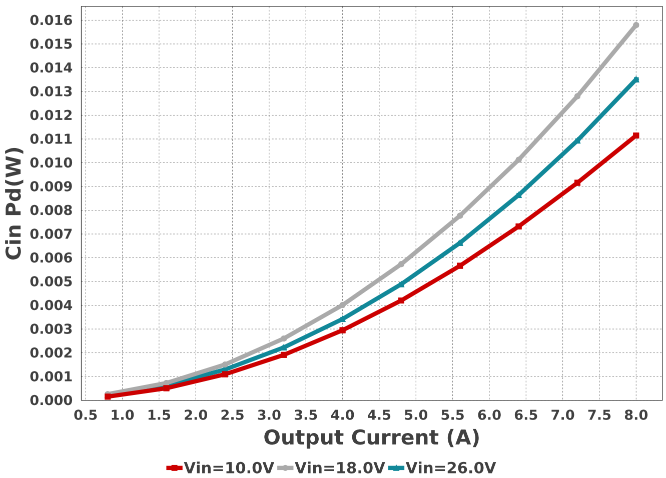
Vout p-p



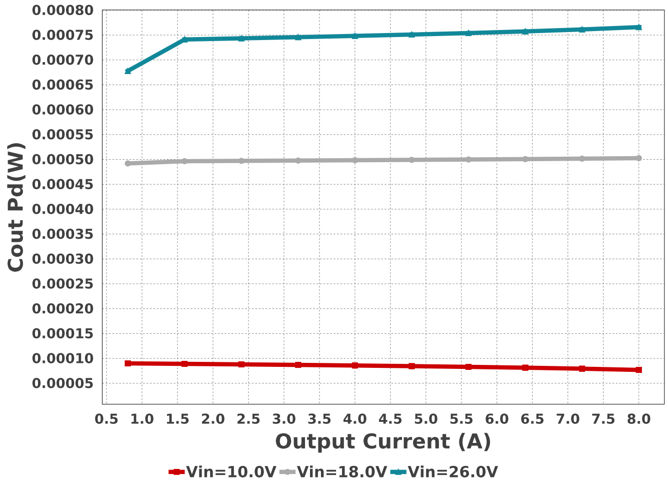
M1 PdCond

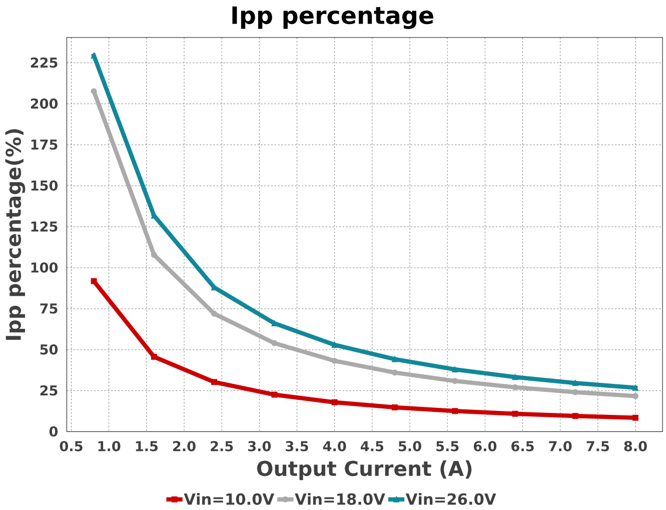


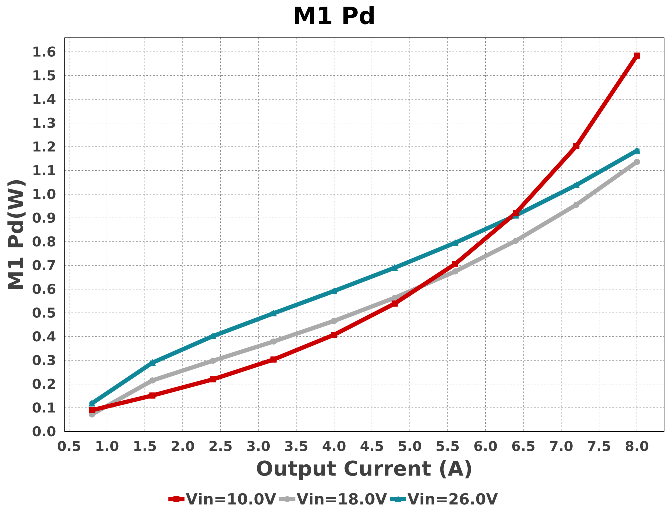
Cin Pd

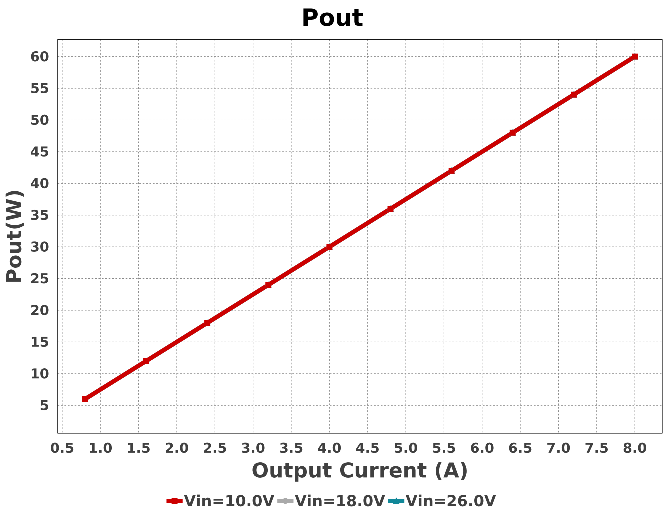


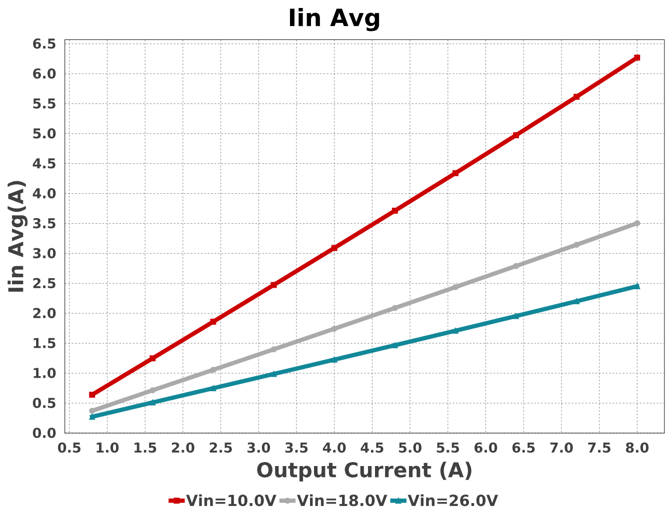
Cout Pd

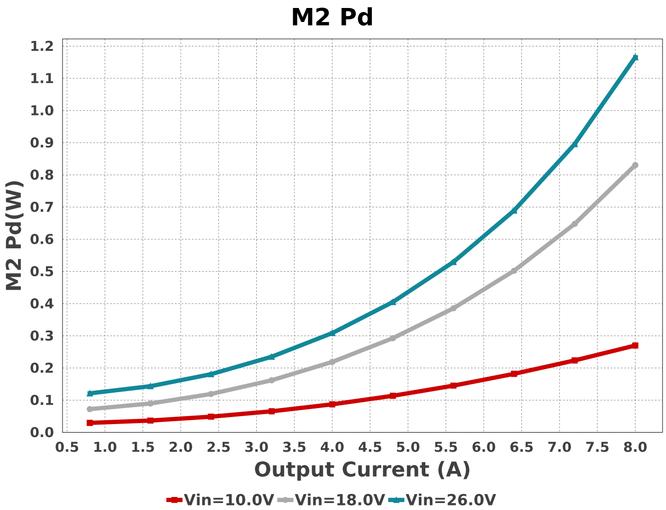


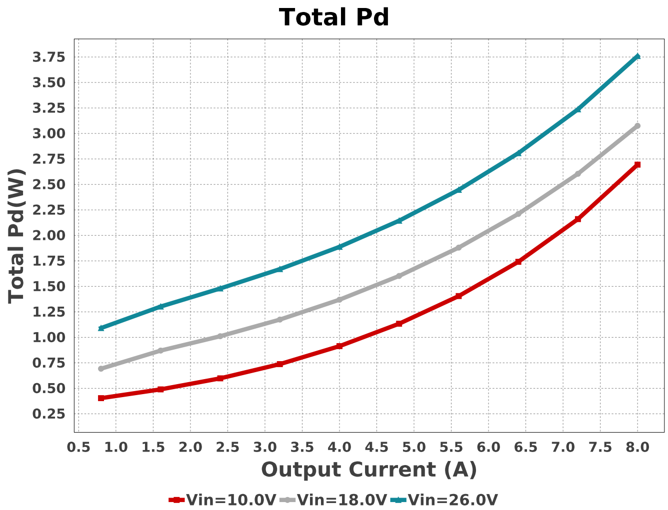

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=10.0V Vin=18.0V Vin=26.0V


M1 Pd
M1 Pd(W)
Output Current (A)
Vin=10.0V Vin=18.0V Vin=26.0V

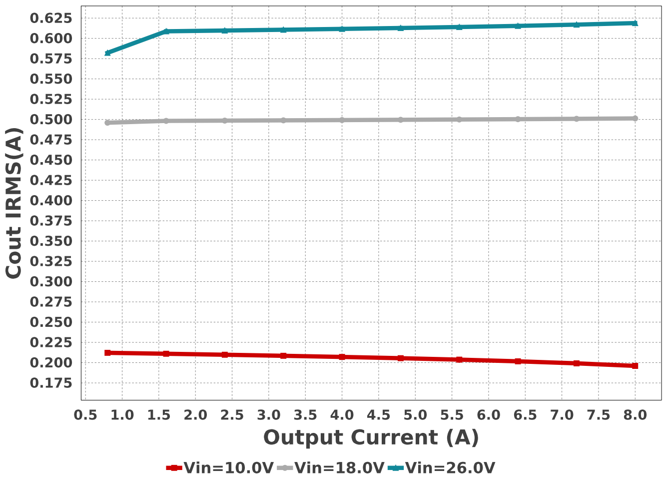

Pout
Pout(W)
Output Current (A)
Vin=10.0V Vin=18.0V Vin=26.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.0V Vin=18.0V Vin=26.0V

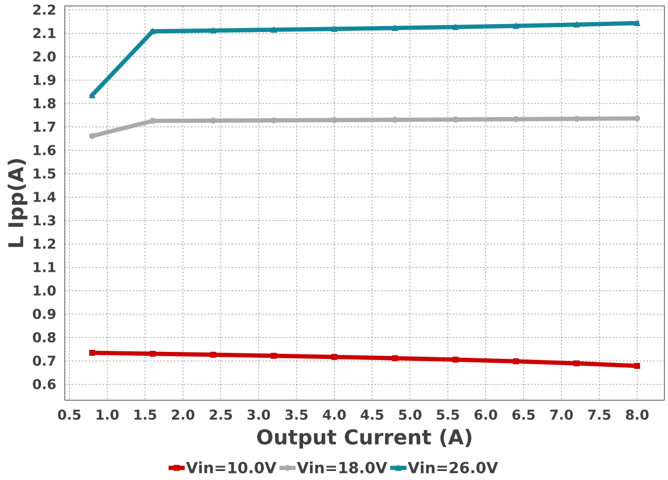

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=10.0V Vin=18.0V Vin=26.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=10.0V Vin=18.0V Vin=26.0V

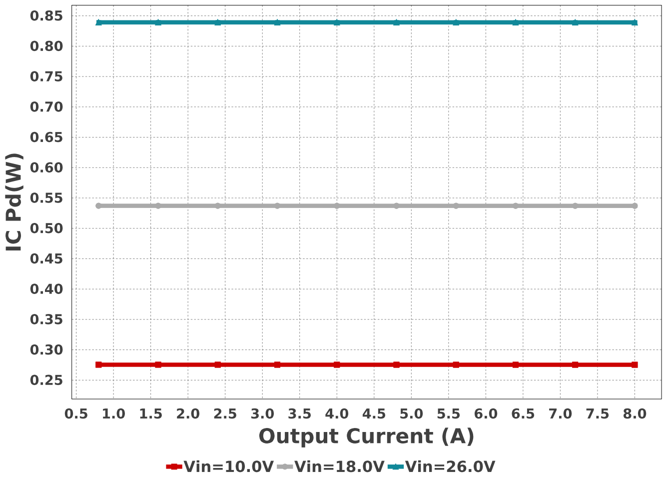
Cout IRMS



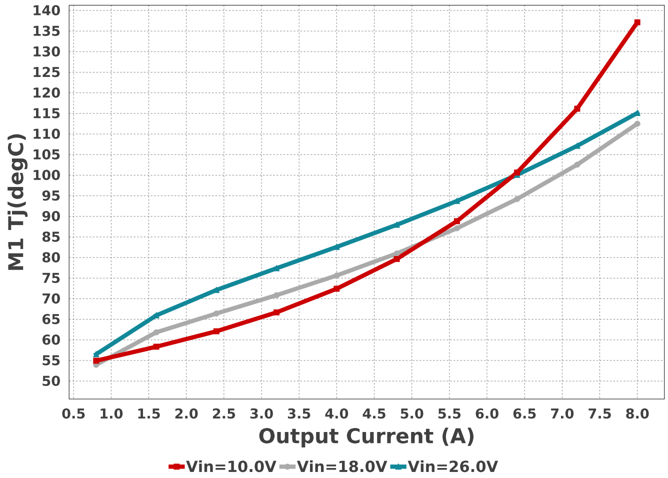
L Ipp



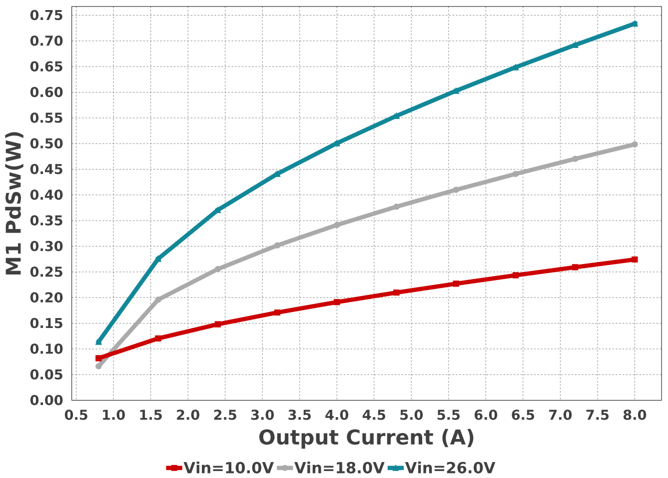
IC Pd



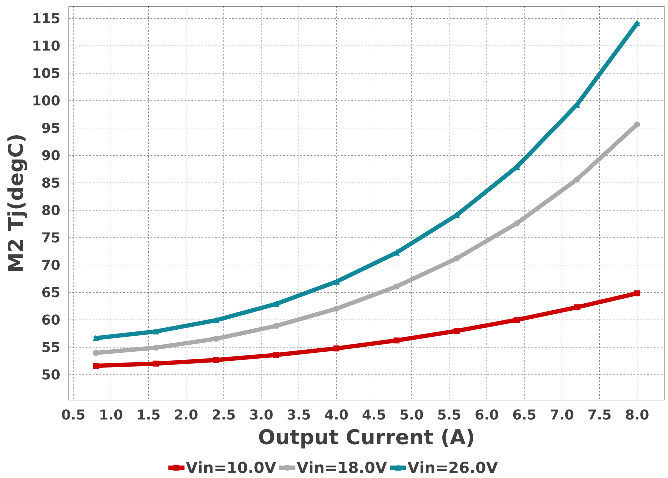
M1 Tj

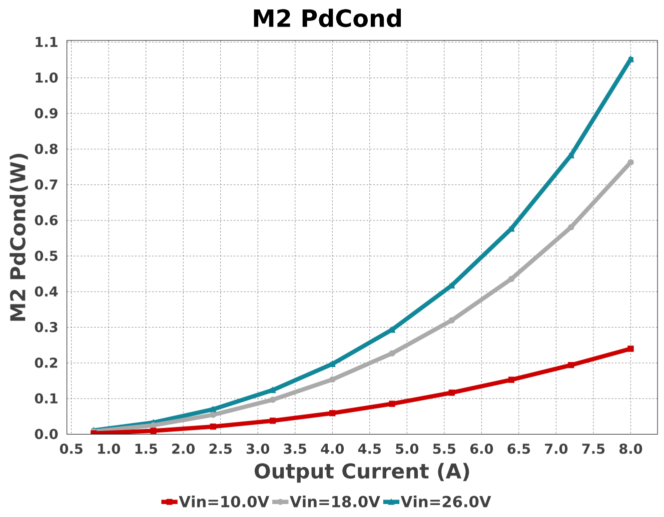


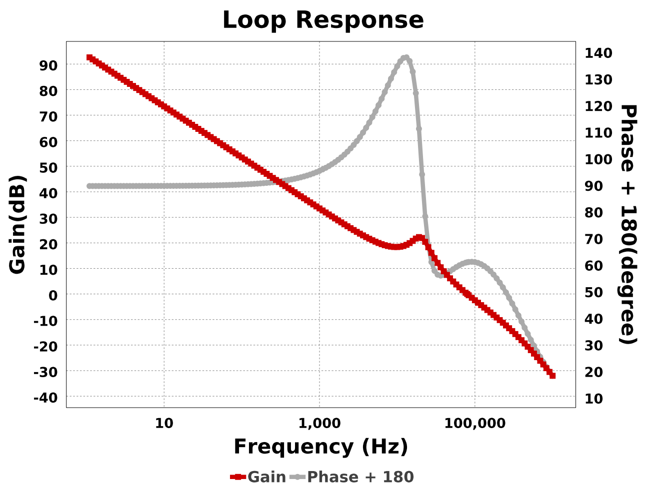
M1 PdSw



M2 Tj







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.676 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	13.51 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	618.856 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	765.96 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	9.072 A	IC	Peak switch current in IC
6.	IC Pd	839.15 mW	IC	IC power dissipation
7.	IC Tj	80.881 degC	IC	IC junction temperature
8.	IC Tolerance	8.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA	36.8 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	2.452 A	IC	Average input current
11.	Ipp percentage	26.797 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	2.144 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	553.69 mW	Inductor	Inductor power dissipation
14.	M1 Pd	1.184 W	Mosfet	M1 MOSFET total power dissipation
15.	M1 PdCond	449.74 mW	Mosfet	M1 MOSFET conduction losses
16.	M1 PdSw	733.73 mW	Mosfet	M1 MOSFET switching losses
17.	M1 Tj	115.091 degC	Mosfet	M1 MOSFET junction temperature
18.	M2 Pd	1.166 W	Mosfet	M2 MOSFET total power dissipation
19.	M2 PdCond	1.052 W	Mosfet	M2 MOSFET conduction losses
20.	M2 PdSw	113.12 mW	Mosfet	M2 MOSFET switching losses
21.	M2 Tj	114.106 degC	Mosfet	M2 MOSFET junction temperature
22.	Cin Pd	13.51 mW	Power	Input capacitor power dissipation
23.	Cout Pd	765.96 µW	Power	Output capacitor power dissipation
24.	IC Pd	839.15 mW	Power	IC power dissipation
25.	L Pd	553.69 mW	Power	Inductor power dissipation
26.	M1 Pd	1.184 W	Power	M1 MOSFET total power dissipation
27.	M1 PdCond	449.74 mW	Power	M1 MOSFET conduction losses
28.	M1 PdSw	733.73 mW	Power	M1 MOSFET switching losses
29.	M2 Pd	1.166 W	Power	M2 MOSFET total power dissipation
30.	M2 PdCond	1.052 W	Power	M2 MOSFET conduction losses
31.	M2 PdSw	113.12 mW	Power	M2 MOSFET switching losses
32.	Total Pd	3.759 W	Power	Total Power Dissipation
33.	BOM Count	24	System Information	Total Design BOM count
34.	Cross Freq	79.551 kHz	System Information	Bode plot crossover frequency
35.	Duty Cycle	29.829 %	System Information	Duty cycle
36.	Efficiency	94.104 %	System Information	Steady state efficiency
37.	FootPrint	245.0 mm^2	System Information	Total Foot Print Area of BOM components
38.	Frequency	769.231 kHz	System Information	Switching frequency
39.	Gain Marg	-43.739 dB	System Information	Bode Plot Gain Margin
40.	Iout	8.0 A	System Information	Iout operating point
41.	Low Freq Gain	92.63 dB	System Information	Gain at 1Hz

#	Name	Value	Category	Description
42.	Mode	CCM	System Information	Conduction Mode
43.	Phase Marg	61.335 deg	System Information	Bode Plot Phase Margin
44.	Pout	60.0 W	System Information	Total output power
45.	Total BOM	$3.695	System Information	Total BOM Cost
46.	Vin	26.0 V	System Information	Vin operating point
47.	Vin p-p	412.191 mV	System Information	Peak-to-peak input voltage
48.	Vout	7.5 V	System Information	Operational Output Voltage
49.	Vout Actual	7.498 V	System Information	Vout Actual calculated based on selected voltage divider resistors
50.	Vout Tolerance	2.823 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
51.	Vout p-p	19.009 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	8.0	Maximum Output Current
SoftStart	3.0 ms	Soft Start Time (ms)
VinMax	26.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	7.5	Output Voltage
base_pn	LM25145	Base Product Number
source	DC	Input Source Type
Ta	50.0	Ambient temperature
UserFsw	769.0 k	Customer Selected Frequency

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

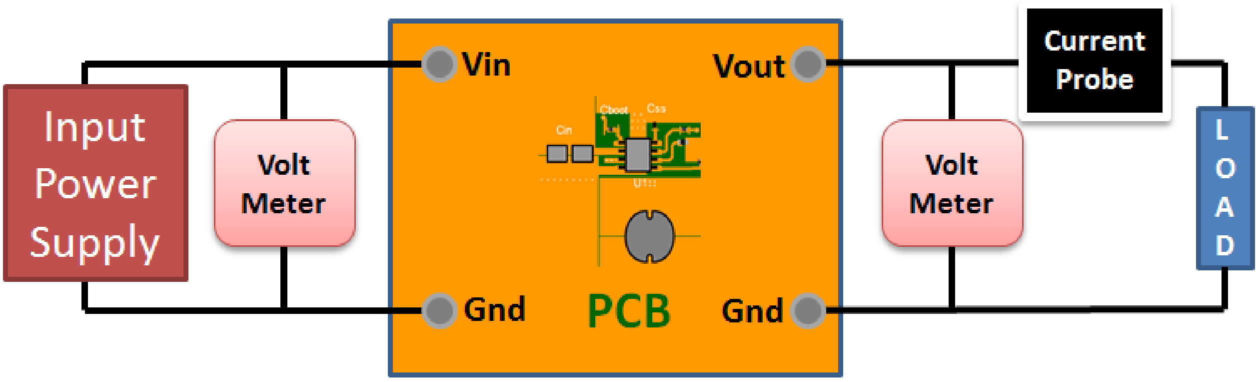
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 10.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. Master key : 8A757A98C798F1C2[v1]

2. **LM25145** Product Folder : http://www.ti.com/product/lm25145 : contains the data sheet and other resources.

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